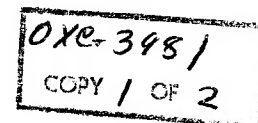


MB-4-532



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20 September 1962

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Dear Norm:

Enclosed herewith is a copy of [] trip report to the West Coast. On pages 2 and 3 you will find reports on elastomer seals for hot vacuums. Although we are continuing to follow any reasonably hopeful alternative to the welded glass to metal seals, you can see that outgassing is a very serious problem and it would appear it precludes any other solution.

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Best regards

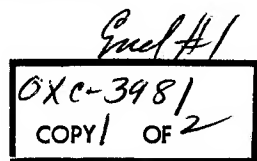
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Enclosure

cc: EPK
ELT ✓

25 YEAR RE-REVIEW



TRIP REPORT

September 17, 1962

TO:

FROM:

CC:

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Vehicle Contractor: [] and I arrived on Wednesday morning and delivered the two windows and associated parts to [] Don acted as if he were surprised to see us and suggested that we just leave the windows there. We explained that the purpose of our trip was to:

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- A. Help in installing the windows in the hatch
- B. Participate in initial flight tests, if possible.

He said that he preferred to install the window in the hatch in the [], that no decision as to flight test would be made until the flight test meeting which was proposed and will probably be held during the week of September 17, and that he felt that no flight testing would be done until after October 1. We looked at the hatch and saw that there is quite a lot of work that has to be done on it before the window could be installed. The notch for the tubulation had not been cut in the ribs, the hatch had not been sealed or pressure tested, and insulation has not been applied. Don felt that there had been ample coordination through our drawings so that work preliminary to actual installation of the window would proceed satisfactorily. He felt that it would be wise for Perkin-Elmer people to be present when the window is fitted to the hatch whether it is in the [] or at his facility. Upon consultation with [] it was decided to leave the windows there and not pursue the matter of installation any further since it was quite obvious that they were not prepared to install the windows at this time.

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Some time was spent with [] discussing thermodynamic problems and results. We discussed document 414 which we received from [] on 4/13/62 (date of drawing is 9/8/61). This document is the results of a computer program showing two dimensional temperatures in type three windows. Our concern was that the outer temperature on this document was noted at 440° rather than the 500° we have been using. It was explained to us by Ben that they were more concerned with gradients in this calculation, and used the temperature of 439° as an input based on certain flight parameters which are not representative of maximum. Furthermore, the emissivity upon which these temperatures are based was

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TRIP REPORT

2

September 17, 1962

not necessarily correct. Ben assured us that 500° is still the best guess as to the operating temperature. He does not expect that operation will exceed this temperature by any significant amount.

[] indicated that they had a requirement for gold coating on their wind shields, and were having a problem procuring such a coating. A meeting was set up with [] and ourselves. I gave them the history of our coating development and indicated that we were in a position to provide a coating and that Liberty Mirror was in a position to provide a coating. I gave them all the information that was necessary that they could contact Liberty Mirror themselves, and cautioned them about the possible connection with our two companies. I also indicated that I would try to provide them with three types of samples of our coating so that they could conduct tests to determine whether our coatings would be suitable for their applications. (I initiated action on 9/17 at P-E to obtain the required samples) I think that we should make an attempt to get samples to them as quickly as possible since this is an area in which they could use our help and need it, and in which there is, in my opinion, a great deal of future profitable business.

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We inquired once again whether the Vehicle People had any B120-VCA titanium in widths of 14" or greater. They did not have any nor do they anticipate obtaining any in the future for this program.

I discussed the aspect of elastomer seals at high temperatures with Don. Don called in the person at his facility who was concerned with sealing. Their sealing applications are primarily on a pressure type particularly fuel seals and gas seals. They do not have even a talking acquaintance with the problems involving vacuum sealing. They indicated that the 3M sealing which was supplied to us by Don was developed as a fuel sealer, and was not at all suitable for vacuum applications at high temperatures. They indicated very definitely that they thought it would be a waste of time to test this material for this application. Based on reading the data sheet and on this information, I do not think it would be worthwhile to conduct any test of this material at this time.

Parker Seal Company: We met with [] Engineering Manager and with [], Project Sales Manager. The following areas were discussed:

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1. We described our sealing problem in detail and explained our time-temperature-pressure requirements. They do not have any elastomers that will meet our requirements. Specifically, Viton is unsuitable because it has 100% compression set after a short time (in the order of one hour) at 500°F. This means that even the new development of degassed Viton rings offer negligible encouragement, since the elastomer itself loses its physical properties at this temperature. On the other hand, silicone rings, which will withstand these temperatures for long periods of time, both outgas at a high rate, and are extremely permeable (50 times the permeability of Viton). They feel that no present material which they

TRIP REPORT

3

September 17, 1962

have or are cognizant of, will be suitable in our application, if used in a conventional sealing method.

2. We attempted to obtain test data for outgassing and permeability rates for their best materials, at 500°F. The maximum temperatures of their tests is about 170°F, and no data is available for 500°F. We did obtain some curves covering the range 72°F to 170°F, and these will be given to [redacted]. However, they pointed out that extrapolation may not be valid, since these curves cover a temperature where the material maintains its physical integrity, and we are interested in a region where the materials break down. They gave us the name of [redacted] at Wright Field ASRCNE-1, extension 28108, Non-Metallic Materials Lab, Wright-Patterson Air Force Base. He is cognizant of overall developments in this field. In addition, they indicated that we could contact [redacted] of RCA who worked closely with them in developing their outgassed O-rings. (It is interesting to note that we contacted [redacted] almost a year ago on this very subject and obtained information from him at that time which is essentially consistent with the information we are now obtaining from [redacted]. A copy of our telephone conversation of last year with Dr. [redacted] is attached.)

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3. Since it was obvious that no conventional techniques employing elastomers were suitable for our application, we tried to think of how elastomers could be used using new techniques to make them suitable for our application. The only elastomer which seems to maintain its physical properties at 500° is silicone. The problem with silicone is that it is permeable. If a metallic coating completely encasing the silicone O-ring could be developed, the problem of permeability would vanish. Parker indicated that they have had some experience and success in applying an aluminum and gold coating over silicone O-rings and silicone gask-O-seals. This seemed to all concerned to be a very interesting possibility and one which may have a very high probability of success. Furthermore, with a small test program, the feasibility of such an approach could be determined. The details of what would be required were established. They shall make circular gask-O-seals for us on a cost basis, and we shall test these sealed to quartz specimens which we had from a previous application. We will share the test results with them. The use of the round one is to be preferred because of the small tooling charge and the ease of making the test setup. If the round ones prove satisfactory, they will supply a 7 x 10 configuration for our test. If this proves satisfactory, it is anticipated that tooling will be made for producing a 14 x 20 gask-O-seal configuration. I am proceeding with the necessary drawings so that they can submit a quotation to us for making the initial circular gask-O-seals employing metalized (aluminum and gold) silicone materials. It is my intention that [redacted] will carry out the testing program under the direction of [redacted].

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TRIP REPORT

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September 17, 1962

We discussed how we might obtain quicker deliveries on critical items and establish a relationship which I think will be beneficial in the future. I think this visit was very worth while from all standpoints.

Swedlow Inc.: We met with [redacted], Supervisor, Contracts Administration and [redacted] Manager, Quality Assurance. Swedlow is the manufacturer from whom we obtained the 37-9X phenolic glass laminates which are used in the non-vacuum configuration. Mr. [redacted] seems to be one of their chief technical people. We discussed with them our application to be certain that we are using the proper material. It appears that we are, although this particular material has some manufacturing difficulties in the thicker pieces. The advantage of this material is that it maintains a very high strength for long term exposure at 500°F. There are other materials which are more commonly used, whose strength decreases rapidly after exposure at 500° for more than ten hours. These materials are not much cheaper, but more easily manufactured.

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They have not completed a purchase order from us in which they were required to manufacture one each of five thicknesses of 37-9X. The reason is they have had difficulties in making the thickest piece. The nature of the difficulty is that the entrapped gasses cause the piece to delaminate during the curing process. They were on their fourth attempt to make this piece when we visited them. They felt that if they could cut out the center prior to curing that the gasses would have a means of escaping and prevent delamination. We provided them with a sketch of how large a center void we could stand.

We discussed in some detail laboratory test results of material properties that they performed as required by our last purchase order. The material exhibits amazingly good physical properties at high temperatures. We also went to the laboratory and did a compression test on one piece.

They gave us the name of a subcontractor who specializes in fabricating plastic parts. They find him very reliable and extremely accurate, and completely cognizant of the techniques required for machining this type of material. He is [redacted], Leed Insulator Company, 711 East Pico Blvd., Los Angeles, California. I am going to follow this up and have them quote on making a non-vacuum 37-9X configuration so that we can obtain price and delivery information for our records. It would be extremely useful to have a vendor in that area so that if during flight test any new parts had to be made, we would have a source available nearby. Furthermore, we have experienced difficulty here machining this material, and having an experienced vendor would be beneficial.

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We had a complete plant tour which we found very interesting. They make many of the plastic parts for missiles and aircraft. They make canopies and windows for most of the commercial as well as military vehicles. I highly recommend that this source of complex plastic parts be kept in mind for any application P-E may have [redacted]

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November 18,

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Viton O-Rings

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On September 19, I discussed a memo covering my telephone conversation with [redacted] of R.C.A. on the subject of the properties of Viton O-Rings. [redacted]'s name was given to me by M.D.R., which he obtained at a suppliers meeting.

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I made a commitment in my memo to report the findings of some preliminary tests and to decide on the basis of these tests whether it would be profitable to pursue a solution to our problem based on the use of Viton O-Rings. I have not been able to accomplish the test I had in mind to date.

I feel that doing these tests at this time would be diluting the efforts which are being applied to a present approach. Since our present approach is getting to a stage where we will be able to evaluate it soon, I would like to defer any tests of Viton O-Rings. Therefore, I propose not to honor the commitment which I made in my previous memo.

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FPV:cm

cc: [redacted]

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19 September 1961

TO: [REDACTED]

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FROM: [REDACTED]

SUBJ: Telephone conversation with [REDACTED] of R.C.A. Research
Laboratories concerning Viton O-Rings

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COPIES: [REDACTED]

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[REDACTED] has done considerable work including spectral analyses of outgassed particles in Viton and silicon materials. All his work has been on systems that are continuously pumped. He has found that the primary outgas products which come from Viton heated to temperatures not exceeding 250°C are CO₂, CO and H₂O.

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If Viton is heated above 250°C decomposition of the material begins to occur and it becomes unsuitable for use in most applications. He has found that by heating the Viton to temperatures above the gassing temperature but below the decomposition temperature in vacuum for a period of about three days, most of the gases left in the material during its manufacture are outgassed. The use of such a pre-treated O-ring in a vacuum system gives results which produce very little outgassing. He has been able to hold pressures down in the range of 10⁻³ mm Hg on systems which have had relatively small pumps.

However, he is rather doubtful whether a system such as the one I described to him, which was essentially the one we are trying to build, would work without an auxiliary vacuum pump attached to it at all times. He felt that the kind of requirements that we talked about require vacuum tube techniques. This means heating the unit well beyond the operating range, say 400°C, to outgas and seal it and then lower it to the using temperature.

As far as the work he has done, he finds no appreciable difference between the various types of Viton made. He is not familiar with the term Viton Hi Vac which I obtained from you. He has obtained Viton O-rings, from [REDACTED] where we also obtain our O-rings. The technical person with which he corresponds at Parker is [REDACTED]

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Two other interesting notes: One is that teflon, being of a similar family as Viton, exhibits similar type properties as Viton and can be used as a sealing material in many applications. The other is that silicon does not have the same mechanical stability, is not as strong, and is more permeable to gases such as Helium than Viton.

Phoncon with [redacted] Page 2

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Any assembly made using Viton has to be designed to accommodate the thermal set which is characteristic of Viton used at a high temperature and pressure.

I feel that the conversation with [redacted] was very enlightening and many valuable things came out of it. I seriously doubt that without a major effort on our part, manpower and time wise, we could fairly evaluate the use of Viton for our problem. However, I am not going to make a decision as to whether we pursue this or not until after I have done some simple preliminary tests, the results of which I will report within several weeks.

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